Window Design Guidelines for Daylight

Good Design Practice

EN32 ***Visual Light Transmission (VLT)*** **(Climate Zones: 1 2 3 4 5 6)**

The amount of light transmitted in the visible range affects the view through the window, glare, and daylight harvesting. These functions are not always best served by the same glazing product. For the effective utilization of daylight, the highest VLTs (0.50 - 0.70) should be used in the glazing located between 6 ft above the floor up to the ceiling. The view windows below 6 ft do not require such high VLTs, so values between 0.35 and 0.50 are acceptable to achieve recommended SHGC values. Higher VLTs are preferred in predominantly overcast climates. VLTs below 0.35 may appear noticeably tinted and dim to occupants and may degrade luminous quality. However, lower VLTs may be required to prevent glare, especially on the east or west façades or for higher window-wall ratios. Lower VLTs may also be appropriate for other conditions of low sun angles or light-colored ground cover (such as snow or sand), but adjustable blinds should be used to handle intermittent glare conditions that are variable.

EN33 ***Color-Neutral Glazing*** **(Climate Zones: all)**

The desirable color qualities of daylighting are best transmitted by neutrally colored tints that alter the color spectrum to the smallest extent. In particular, avoid green and bronze colored glazing.

EN34 ***Reflective Glass*** **(Climate Zones: all)**

To the greatest extent possible, avoid the use of reflective glass or low-e coatings with a highly reflective component. These reduce the quality of the view and the mirrored effect is unpleasant to occupants after dark.

EN35 ***Light to Solar Ratio*** **(Climate Zones: all)**

The use of high-performance and selective low-e glazing reduces the visual light transmission (VLT) proportionately less than do reflective coatings or tints. Dividing the VLT by the solar heat gain coefficient (SHGC) is a good rating of the performance of the glass. If the result is less than 1.0, then the glass is a poor choice for visual quality and daylighting. If the result is higher than 1.55, it is a high-performance option.

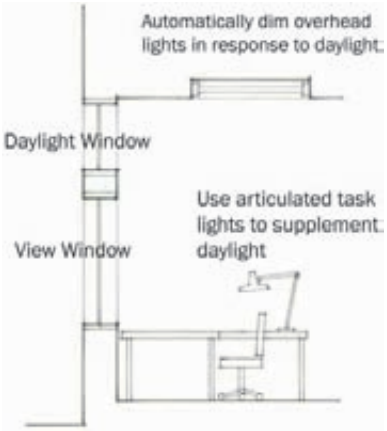
EN36 ***Effective Aperture (Daylight)*** **(Climate Zones: all)**

The window-wall ratio (WWR) times the visual light transmission (VLT) in an individual space results in the “effective aperture,” predicting the daylighting potential of the glazing. Depending on the latitude and predominant sky conditions (clear or overcast), effective apertures for daylighting are generally between 0.15 and 0.30. The smallest effective aperture that will meet daylighting needs should be pursued. It is unlikely that sufficient daylighting savings or user acceptance will be realized with effective apertures much less than 0.15. Increases in either the WWR or the VLT will have a corresponding impact on the thermal characteristics of the glazing system. Balance the visual requirements of the daylighting design with the thermal comfort and performance of the building envelope and HVAC system.

EN37 *Preferred Window-Wall Ratios (WWR)* (Climate Zones: all)

For view and a positive connection to the out-of-doors, people prefer a minimum 20% to 30% ratio of window area to wall area. Glazing the wall areas below desk height (0-30 in. above the floor) offers little or no benefits for daylighting an office.

EN38 (Climate Zones: all)



High, continuous windows are more effective than individual or vertical windows to distribute light deeper into the space and provide greater comfort for the occupants. Try to locate the top of windows close to the ceiling line (for daylighting) but locate the bottom of windows no higher than 48 in. (for view). Consider separating windows into two horizontal strips, one at eye level for view and one above to maximize daylight penetration. See Figure 4-20.

Figure 4-20. (EN38) Daylight window and view window.

EN39 *High Ceilings* (Climate Zones: all)

More daylight savings will be realized if ceiling heights are 10 ft or higher. Greater daylight savings can be achieved by increasing ceiling heights to 11 ft or higher and specifying higher VLTs (0.60-0.70) for the daylight window than for the view windows. North-facing clerestories are more effective than skylights to bring daylight into the building interior.

EN40 *Light Shelves* (Climate Zones: all)

Consider using interior or exterior light shelves between the daylight window and the view window. These are effective for achieving greater uniformity of daylighting and for extending ambient levels of light onto the ceiling and deeper into the space. Some expertise and analysis will be required to design an effective light shelf. See Figure 4-21.

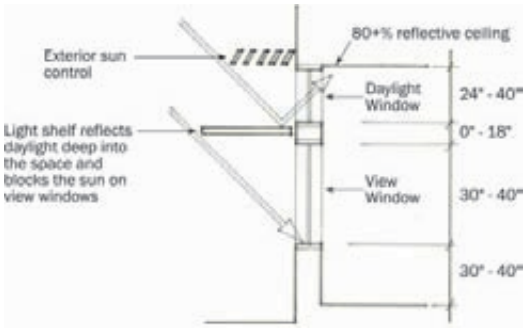


Figure 4-21. (EN40) Wall section for daylighting.

EN41 *Window and Office Placement* (Climate Zones: all)

Daylighting is more cost-effective if open plan workstations are located on the north and south sides of the building since open plan areas are more continuously occupied and achieve lower savings from occupancy sensors. The open configuration also absorbs less light, and interreflections provide a more uniform distribution of light deep into the space. The control of heat and glare on the east and west façades is difficult because daylight and views are blocked in an effort to properly control the low sun angles of morning and evening hours. By placing private offices on the east and west, occupants can individually control their blinds and thereby control thermal discomfort and glare.

EN42 ***Interior Sun Control* (Climate Zones: all)**

Similar to exterior sun control, horizontal blinds on the south windows and vertical blinds on the east and west are most effective. In northern latitudes, low angles of sun can enter the north windows on summer mornings and afternoons. Vertical blinds that retract fully for the middle of the day are recommended for these conditions. Perforated blinds and translucent shades may cause glare when hit by direct sunlight.

References

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LBL. *Daylight and Windows*. LBL Tips for Daylighting with Windows. Berkeley, Calif.: Lawrence Berkeley National Laboratories. http://windows.lbl.gov/daylighting/designguide/designguide.html

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LIGHTING

Daylighting

Good Design Practice

DL1 ***Savings and Occupant Acceptance* (Climate Zones: all)**

Daylighting will only save energy if the electric lighting consumption is reduced and heat gain and loss through glazing is controlled. In addition, glare and contrast must be controlled so occupants are comfortable and will not override electric lighting controls. See additional comments related to window design and placement (EN32 through EN41).

DL2 ***Occupancy Sensors and Task Lighting* (Climate Zones: all)**

Use of "manual-on" occupancy sensors in daylighted spaces saves energy because electricity is not automatically consumed unnecessarily. Use of local articulated task lights (desk lamps that can be adjusted in three planes) in daylighted spaces increases occupant satisfaction and is an effective supplement for daylighting. See Figure 4-20.

DL3 ***Surface Reflectances* (Climate Zones: all)**

The use of light-colored materials and matte finishes in all daylighted spaces increases efficiency through interreflections and greatly increases visual comfort. See EL3.

DL4 ***Furniture Partitions* (Climate Zones: all)**

Lower furniture partitions in open plan office areas increase the efficiency of both the daylighting and the electric lighting system by reducing absorption and unwanted shadows. See EN41 and EL1.